Chapter 2

THEORY BUILDING

The purpose of this chapter is to identify the basic issues and procedures in theory building as background for considerations of similar work in the field of curriculum. In the following pages, we will review the meanings that have been associated with the word "theory" and identify some of the primary functions, structures, and processes associated with theory building by those who have labored at theory construction. We may use as paradigms the experiences of those who pioneered in the natural and social sciences, particularly the social sciences. We and they are bound by certain common rules of behavior in theorizing, and the primary reason for search into what others have done is to learn what those rules are. The common rules of theorizing then will be applied to past and future developments briefly in educational theory and then more thoroughly in curriculum theory since curriculum theory is our principal concern in this book.

Whenever scholars have lacked experience in theory development in a field of endeavor, it has been customary for them to look to the patterns set by those who have been successful and to use those patterns as paradigms for beginning efforts. Since there have been but meager efforts at theory construction and use in education, those who would do theory building in education need to find ways of borrowing, relating, and associating the theoretical experiences of other social scientists as beginning focal points for their own efforts. As an applied social science, education must look to original sources in the established social science disciplines for guiding structures, processes, and rules. Parsons gave support to this kind of borrowing in theory development in human affairs when he indicated: ". . . good general theory in the field of human action, no matter how firmly grounded in one discipline, is inevitably interdisciplinary theory."[1]

THEORY DEFINED

There is general agreement that a theory is a set of related statements explaining some series of events, but as one might expect, there are disagreements about what the character of the statements should be. As stated by Logan and Olmstead:

> Everyone agrees that a theory is, among other things, a set of statements; there is disagreement about what other characteristics any set of statements must have in order to be labeled "theory."[2]

Statements about sets of events differ greatly in complexity. In part, the variation is due to the scope of the series of events. In part, it is due to the degree of sophistication with which the set of events has been treated by theorists in the field of endeavor. In spite of these differences, nearly all serious writers on theory have defined the term one way or another. Some example definitions of theory will help to illustrate convergent and divergent viewpoints about the meanings associated with theory. It appears that theory definitions may be characterized by one or more of three dimensions: unifying statements, universal propositions, and/or predictive statements.

Most definitions of theory express unification of phenomena within the set of events encompassed by the theory. Kaplan expressed it thus:

> A theory is a way of making sense of a disturbing situation so as to allow us most effectively to bring to bear our repertoire of habits, and even more important, to modify habits or discard them altogether, replacing new ones as the situation demands. In the reconstructed logic, accordingly, theory will appear as the device for interpreting, criticizing, and unifying established laws, modifying them to fit data unanticipated in their formation, and guiding the enterprise of discovering new and more powerful generalizations.[3]

[1]Talcott Parsons, "General Theory in Sociology," *Sociology Today,* edited by Robert K. Merton, Leonard Broom, and Leonard S. Cottrell, Jr. (New York: Basic Books, Inc., 1959), p. 37.

[2]Frank Logan and David Olmstead, *Behavior Theory and Social Science* (New Haven: Yale University Press, 1955), p. 4.

[3]Abraham Kaplan, *The Conduct of Inquiry* (San Francisco: Chandler Publishing Company, 1964), p. 295.

Brodbeck compared theoretical and common language when she wrote:

> Language consists of words and sentences. To the *words* of ordinary speech correspond the *concepts* of science; to the *sentences* its *definitions*, its *statements* of *individual fact* and *of laws*. Certain sets of sentences constitute the *theories* of science.[4]

Hall and Lindzey stated that a theory is a set of conventions that "should contain a cluster of relevant assumptions systematically related to each other and a set of empirical definitions."[5] O'Connor noted that in contrasting theory from practice we ". . . refer to a set or system of rules or a collection of precepts which guide or control actions of various kinds."[6] Snow summarized his concept of a theory when he stated:

> In its simplest form, a theory is a symbolic construction designed to bring generalizable facts (or laws) into systematic connection. It consists of a) a set of units (facts, concepts, variables) and b) a system of relationships among the units.[7]

Rudner defined theory as ". . . a systematically related set of statements, including some lawlike generalizations, that is empirically testable."[8] From such definitions one catches the spirit of theory as a unifying phenomenon. The idea of "set" as a homogeneous group of statements seems to be a basic concept in theorizing.

The character of a set of statements making up a theory is delimited when the definition of a theory specifies what kinds of statements are demanded and how they are to be derived. A definition by Rose illustrates:

> A theory may be defined as an integrated body of definitions, assumptions, and general propositions covering a given subject matter from which a comprehensive and consistent set of specific and testable hypotheses can be deduced logically.[9]

[4]May Brodbeck, "Logic and Scientific Method in Research on Teaching," *Handbook of Research on Teaching*, N.L. Gage, editor (Chicago: Rand McNally and Company, 1963), pp. 44-45.

[5]Calvin S. Hall and Gardner Lindzey, *Theories of Personality* (2d ed.; New York: John Wiley and Sons, Inc., 1970), p. 11.

[6]D.J. O'Conner, *An Introduction to the Philosophy of Education* (London: Routledge and Kegan Paul, 1957), p. 75.

[7]Richard E. Snow, "Theory Construction for Research on Teaching," *Second Handbook of Research on Teaching*, Robert M. W. Travers, editor (Chicago: Rand McNally & Company, 1973), p. 78.

[8]Richard S. Rudner, *Philosophy of Social Science* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1966), p. 10.

[9]Arnold M. Rose, "Generalizations in the Social Sciences," *American Journal of Sociology*, 59:52, August, 1953.

By these criteria, the set of statements would include definitions, assumptions, and general propositions with specified relational properties. On a somewhat more complicated level, theories are related to laws, hypotheses, and logico-mathematical deductions. Abel used the following words to voice his interpretation of general theory in the social sciences:

> A general theory is built upon the facts discovered by means of the use of theorems and other conceptual models from empirical data and which have been expressed in the form of laws, correlations, or other types of generalizations. It involves synthesis and is directed to the formulation of propositions about universals.[10]

Feigl's frequently quoted definition is in a similar vein, but it is more detailed.

> I propose to define a "theory" as a set of assumptions from which can be derived by purely logico-mathematical procedures, a larger set of empirical laws. The theory thereby furnishes an explanation of these empirical laws and unifies the originally relatively heterogeneous areas of subject matter characterized by those empirical laws. Even though it must be admitted that there is no sharp line of demarcation (except a purely arbitrary one) between theoretical assumptions and empirical laws, the distinction, at least in the sense of gradation, is illuminating from a methodological point of view.[11]

In addition to the two dimensions of unification and universal propositions, a third needs to be added to complete the characterization of theory definitions, and that is the dimension of prediction. Some theorists choose to define theory so that prediction is the key dimension. For example, Travers noted that a theory consists of generalizations intended to explain phenomena and that the generalizations must be predictive.[12] Actually, a full definition of theory satisfies all of these characteristics. Kerlinger combined all of the dimensions that have been mentioned when he wrote the following:

> A theory is a set of interrelated constructs (concepts), definitions, and propositions that present a systematic view of phenomena by specify-

[10] Theodore Abel, "The Present Status of Social Theory," *American Sociological Review*, 17:162, April, 1952.

[11] Herbert Feigl, "Principles and Problems of Theory Construction in Psychology," *Current Trends in Psychological Theory* (Pittsburgh: University of Pittsburgh Press, 1951), p. 182.

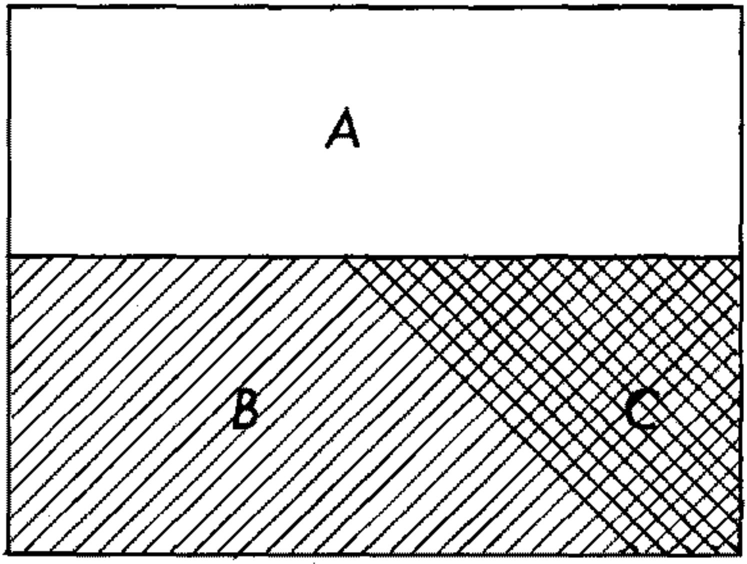
[12] Robert M. W. Travers, *An Introduction to Educational Research* (3rd ed.; New York: The Macmillan Company, 1969), p. 10.

ing relations among variables, with the purpose of explaining and predicting the phenomena.[18]

These various definitions of theory lead to the tentative conclusion that there must be different kinds of theories derived by different processes. We will explore this notion in the following sections on the structures, functions, and processes in theory building.

STRUCTURAL ELEMENTS OF THEORY

We can further expand our insights and understandings of theory building by examining briefly the principal structures and functions of theories. Figure 2 is a representation of a generalized set of events that normally constitutes a theory. In Figure 2, the



ABC = The universal set
A = Events of known dimensions
B = Events of assumed dimensions
C = Events of unknown dimensions

Figure 2. *A set of events constituting a theory.*

[18]Fred N. Kerlinger, *Foundations of Behavioral Research* (2d ed.; New York: Holt, Rinehart and Winston, Inc., 1973), p. 9.

universal set represented by ABC is the set of events to be explained by the theory. The universal set is subdivided into three subsets: A, B, and C. Subset A represents those events of known dimensions, which might be expressed as statements of fact, law, or principle. Subset B represents those events of assumed dimensions, which might be expressed as assumptions, propositions, postulates, or in some other way to reflect tentative information that does not reach the pinnacle of certainty exemplified by fact or law. Subset C represents those events that are part of the universal, or total, set of events for which adequate explanation is not yet available. The task of the theorist is to formulate terms and statements that will explain the contents of the various subsets of the theory and to show their interrelationships.

Terms

A crucial aspect of a scientist's work is his use of technical terms. He is obligated, as a scientist, to carefully define his terms and to use them consistently thereafter in his work. Such consistency is particularly relevant in theorizing. There are various ways of designating the classes of terms used in theory work. Selected examples will help to illustrate the point. Brodbeck said:

> A theory contains two classes of descriptive terms: basic or "primitive," and defined. The basic terms of a theory are those that are not themselves defined within the theory, but all other descriptive terms of the theory are defined by means of them. The basic terms of a theory must occur in its axioms and may also reoccur in its theorems. Its defined terms occur only in the theorems.[14]

Under the subject of "theoretical terms," Kaplan specified observation terms, indirect observable terms, constructs, and theoretical terms. However, he indicated little consistency in use of this nomenclature and ended his discussion by noting that there really are no differences among the discriminations.[15] Gordon and others divided theory into three main classes: primitive terms, key terms, and theoretical terms.[16] Primitive terms cannot be

[14]*Op. cit.*, p. 70.

[15]Abraham Kaplan, *The Conduct of Inquiry* (San Francisco: Chandler Publishing Company, 1964), pp. 54-60.

[16]Ira J. Gordon, Chairman, "Theories of Instruction: A Set of Guidelines," a position paper prepared by the Commission on Instructional Theory and presented at the Annual Conference of the Association for Supervision and Curriculum Development, NEA at Dallas, Texas in March, 1967.

operationally defined; they maintain a constant meaning. The concept *point* in geometry is a good example. Key terms are those which must be operationally defined such as *reinforcement* or *problem solving.* Theoretical terms are operationally defined but in relationship with key terms. *Motivation* and *set* are examples. Sophisticated theories will contain all three types of terms.

Despite the various ways of designating classes of terms, the theorist probably should be aware of at least three classes he might be called upon to choose and use. They may be called general language terms, basic concepts, and theoretical constructs. The first are those terms that are used in science and in general language in common. These are the words that make the sentences of a theory such as many of the verbs and adjectives. It is not necessary that they be defined at all, much less operationally defined, because their use has become commonly accepted. A second group consists of those concepts that are basic to the set of events being explained. These are well-defined constructs, and they are usually operationally defined. Such terms as *molecule* in chemistry, *mass* in physics, or *curriculum* in education would fit in this category. A third group consists of those that are essential to the theory. These words have meaning for the system of events being encompassed by the theory, but they cannot be identified by direct observation. Such terms as *emotional need*, *persecution complex*, or *attitude* belong in this category.

Statements

A theory, by definition, contains a set of statements within which terms are used. The statements themselves fall into different classes just as the terms do. Statements are referred to differentially as facts, definitions, propositions, hypotheses, generalizations, axioms, postulates, theorems, assumptions, and laws. Sometimes these referents are used interchangeably and in slightly varying contexts, and some of them are more or less self-explanatory. But for purposes of remaining clear as to their use in this text, even the more self-evident will be defined.

A fact is a phenomenon known by observation. A definition is a formal statement of meaning or signification. A proposition is a formal statement affirming or denying something about a subject.

Hypotheses, generalizations, axioms, postulates, theorems, and laws are special cases of the proposition. An hypothesis consists of one or more propositions designed to explain a set of events. A generalization is a proposition which makes an assertion about one or more members of a class; it is derived by inference from observed relationships. An axiom, or a postulate, is a proposition assumed to be true. A theorem is a proposition derived by reasoning or deduced from axioms. A law is a proposition that remains invariable given unchanging conditions. In essence, it is a generalization accepted by the scientific community. An assumption is a conjecture, or supposition, that may take the form of an axiom, postulate, theorem or hypothesis. It helps the theorist to look at theory statements in the light of the functions expected of theories.

FUNCTIONS OF THEORY

Our understanding of the meaning of theory may be augmented if we note some of the functions associated with theory. The range of these is very broad, but at the same time they lack cohesiveness. Theorists may exhibit different focal points for their efforts, but at the same time there is general agreement among scientists and philosophers of science that ". . . theories fulfill the three functions of, (1) description, (2) prediction, and (3) explanation."[17] These functions bear upon the theory that the scientist tries to understand, and they have implications for persons who may be using theories. Gowin acknowledged the latter when he said:

> But turn theory around and point it toward the person using the theory. A different set of functions seems to be prominent when we look at the theorist at work in research. Here the theory helps the researcher to *analyze* data, to make a short-hand summarization or *synopsis* of data and relations, and to *suggest* new things to try out. Theory functions in analysis, in synopsis, in power of suggestion or speculation. Theory functions as something to think with, to help in one's work.[18]

Probably the most simple function of a theory is to provide a system for classifying the knowledge of that theoretical field.

[17]O'Connor, *op. cit.*, p. 81.

[18]D.B. Gowin, "Can Educational Theory Guide Practice?" *Educational Theory,* 13:8, January, 1963.

Homans has expressed this function in the following picturesque way:

> Even the most fragile theory has its uses. In its lowest form, as a classification, it provides a set of pigeonholes, a filing cabinet, in which fact can accumulate. . . . In time the accumulation makes necessary a more economical filing system, with more cross references, and a new theory is born.[19]

The ordering of facts and observations into some scheme is fundamental to description of any field about which theorizing is to be done. It is a way of arranging information so that the scope and the internal relationships of the total body of information is more visible. As Brodbeck stated: "A theory not only explains and predicts, it also unifies phenomena."[20]

At a higher level, those functions are added that permit moving beyond classification or collection of facts to action of broader scope such as that involved in induction and prediction. Whereas it is true that the ordering of information in a systematic manner is a task of theorizing, the task really is but a prelude to the fulfillment of the larger functions of theory. With these being description, prediction, and explanation, theory building reaches its most systematic level when the resulting theory becomes a full-blown logico-deductive system, or a logico-mathematical system. These high-level goals are reached most easily in the natural sciences, but in the social sciences the complications of the sets of events to be explained by theories may force theorists to temporarily lesser levels of achievement. Very few theoretical systems utilizing symbols and mathematical structures have been created in the social sciences. Instead, verbal models are used extensively as ways of representing particular phenomena. Nevertheless, theories in the social sciences must meet the basic criteria for theorizing and these include the organization of relationships so that they are better explained and so that predictions can be made for events not yet observed from known relationships.

We return for a moment to Kerlinger's definition which illustrates the three theory functions of description, prediction, and explanation. First, the definition calls for description through

[19]George Homans, *The Human Group* (New York: Harcourt, Brace and World, Inc., 1950), p. 5.
[20]*Op. cit.*, p. 70.

PROCESSES IN THEORY BUILDING

More insight into theory and its processes is possible by examining selected tasks performed by the theorist. Two things stand out glaringly. One is that the range of activity is large. The second is that working rules tend to be dictated more by the choice of activity than by any arbitrary set of rules for theory building. These points may be amplified by an examination of some of the suggestions that have been made.

The language used in theory building is a matter of concern as exemplified by the attention currently being given to discovery and delineation of concepts and to the problems of definition of terms. For example, Homans listed the following rules for theory builders, most of which have to do with problems of communicating:

> Look first at the obvious, the familiar, the common. In a science that has not established its foundations, these are the things that best repay study.
>
> State the obvious in its full generality. Science is an economy of thought only if its hypotheses sum up in a simple form a large number of facts.
>
> Talk about one thing at a time. That is, in choosing your words, (or more pedantically, concepts) see that they refer not to several classes of fact at the same time but to one and to one only. Corollary: Once you have chosen your words, always use the same words when referring to the same thing.
>
> Cut down as far as you dare the number of things you are talking about. "As few as you may; as many as you must," is the rule governing the number of classes of fact you take into account.
>
> Once you have started to talk, do not stop until you have finished. That is, describe systematically the relationships between the facts designated by your words.
>
> Recognize that your analysis must be abstract, because it deals with only a few elements of the concrete situation. Admit the dangers of abstraction, especially when action is required, but do not be afraid of abstraction.[23]

Mouly identified the following four characteristics of a good theory which have implications for theory-building activities:

[23]*Op. cit.*, pp. 6-17.

> 1. A theoretical system must permit deductions which can be tested empirically — i.e., it must provide the means for its own interpretation and verification. . . .
>
> 2. Theory must be compatible both with observation and with previously validated theories. . . .
>
> 3. Theories must be stated in simple terms; that theory is best which explains the most in the simplest form. . . .
>
> 4. Scientific theories must be based on empirical facts and relationships.[24]

More specifically, curriculum theorists need to think in terms of the precise activities they perform when working at theorizing. One such activity is the formulation of definitions. A second is the classification of relevant information into homogeneous categories. A third is the utilization of the inductive and deductive processes. A fourth, and very important one, is the making of inferences and predictions and the testing of them in the crucible of research. A fifth is the development of models. A sixth is sub-theory formation. All six of these principal theory-building activities are crucial; therefore, each of them will be discussed more fully in the following pages.

Definition of Terms

Description of theory, rules laid down by Homans, and the characteristics described by Mouly, all carry the emphatic message that careful definition of terms is an essential ingredient in the work of a theorist. Two rules seem to govern the activity of definition. One is clarity of wording to assure exact meaning; the other is consistency in use of terms once they have been defined. The terms or constructs of any area of scientific endeavor are the subject matter of that area. The technical terms or constructs of physics and biology, for instance, distinguish between the two sciences. They are the tools for thinking and communicating.

If the reader were to review any significant portion of the literature discussing kinds of definitions and rules for making them, he would find a plethora of names attributed to different kinds of definitions and different kinds of terms or concepts. The

[24] George J. Mouly, *The Science of Educational Research* (2d ed.; New York: American Book Company, 1970), pp. 70-71.

terms that the theorist is most likely to be concerned with are general terms, basic concepts, and theoretical terms. For purposes of establishing definitions, the theorists would be concerned primarily with the basic and theoretical terms. It should be kept in mind here that the basic terms are axiomatically defined while the theoretical terms must be operationally defined.

Brodbeck distinguished between nominal and operational definitions.[25] Nominal definitions give the attributes associated with the term or concept. In this way a term is explained by listing the boundaries of interpretation. Operational definitions, on the other hand, are more complicated in that the conditions under which a concept is used are a part of the definition. The operational definition assumes an "if-then" condition, meaning that if certain conditions exist, then the statement within which the term is used is true. Or, a term is recognized if prescribed conditions exist. When a term is a theoretical term, the concept usually is called an operational construct.

There seems to be universal agreement that definition of technical terms is an important and a critical activity for the theorist. Two reasons predominate. The selection and definition of terms or concepts aid in defining the subject matter boundaries for the theorist's work, and the consistent use of the defined terms facilitates explanation and prediction.

Classification

Classification is another theory-building activity. It is reiterated here that Homans referred to classification as the lowest form of theory, but he pointed out the possibility of a classification system becoming or producing new theory. Classification, however, need not always be thought of as a simple pigeonholing activity. Hall and Lindzey suggested that one of the functions of a theory is to incorporate known findings into a consistent and reasonable framework.[26] In this sense, classification as a theory-building activity becomes a means of organizing and integrating what is known about the areas in which the theorizing activity is being conducted. Through classification, it is possible for

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[25]*Op. cit.*, pp. 48-51.

[26]Hall and Lindzey, *op. cit.*, p. 13.

the classifier to become aware of the voids in knowledge necessary to give meaning to a given activity or series of events. It is the function of research to fill these gaps. The observation of relationships among classified elements can be included as part of the classification activity.

Sometimes a developed classification scheme, or a taxonomy, actually is called a theory. Such designation is often misleading because a classification scheme cannot fulfill all of the requisites of a theory. Classification as a theorizing activity helps to group facts and generalizations into homogeneous groups, but it does not explain the interrelationships among the groups or the relationships among the facts and generalizations within any single group. In a sense, developing a classification scheme is a terminal activity. A theory, on the other hand, fosters new relationships and conditions for understanding. Nonetheless, the development of classification schemes is a theorizing activity, even though it may be done in the early stages of theory development.

Induction and Deduction

Induction and deduction are the two basic processes for generating theoretical statements beyond those of definition of terms and arrangement of classification schemes. Induction is a process whereby a larger generalization is derived from a set of facts of more limited scope. By so doing, the inductive argument allows the theorizer to extend the range of his knowledge. For example, a person notes that all dogs he has observed have had a liver, and he concludes that all dogs have livers. His conclusion contains information not present in his premise, and the conclusion is probably true, but not necessarily true, if the premise is true. In a sense, a generalization arrived at through research has an inductive relation to the evidence supporting the generalization.

Deduction is a process whereby a conclusion is reached that is entirely conclusive or entirely inconclusive. The conclusion is restricted by the premises of the argument. For example, if we observe that every mammal has a liver and that all dogs are mammals, we may conclude that every dog has a liver. Thus, the deductive argument makes explicit the content of the premises of the argument.

From the definitions of theory given earlier in the chapter, it can be seen that different kinds of theory are produced by the inductive and the deductive processes. The inductive process tends to produce normative or prescriptive types of theory; whereas, the deductive process tends to produce logico-deductive types of theory. Since both prescriptive and deductive statements normally are used at one stage or another in the development of theories in the social sciences, it would be an error to say that one of the two processes is preferential. Both processes are implicitly or directly demanded by the definitions of theory and the theory-building processes discussed thus far, but induction and deduction become critical when one thinks about inference, prediction, and research as theory processes.

Inference, Prediction, Research

A complex of theory-building activities may be included under the process of inference. In general, the act of inferring means to go beyond the known or the observed. More specifically, the activities may include making assumptions, deriving hypotheses, reaching generalizations from observations, and deducing from observations and generalizations.

A theorist is forced to make assumptions because, by definition of theory, he is faced with the problem of explaining the character of and the relationships among events that are both known and unknown. For example, he may assume the nature of theoretical constructs, or he may assume axiomatic conditions. He may assume pertinence of additional facts or cause and effect relationships among various events within the total set of events. He may make any of these assumptions for purposes of establishing continuity or meaning in his theory, or he may make them for operational purposes in a research program.

The use of the hypothesis in theory building is as clear as it is in research. It is a testable supposition about relations among identified phenomena; it is simply a device for verifying a stated assumption so as to reach a conclusion. From repeated use of the hypothesis, the theory builder can formulate postulates, theorems, or laws governing the interrelationships of his theory elements.

The two additional activities mentioned above as related to the process of inference are generalization and deduction. These were somewhat discussed earlier under induction and deduction as primary theory-building processes. Repeatedly, a theorist observes events and then generalizes from related or similar results. Some generalizations are reached by concluding from the acceptance of premises considered to be true. Scientific generalizations, however, are induced from supporting evidence. Deduction produces generalizations, or conclusions, that must be completely true so long as the evidence leading to the conclusion are valid evidence. A theorist concludes from a series of generalizations a law or theorem in which he has great confidence.

There is no question but that some of the terms included here under the concept of inference are used interchangeably or synonymously in the literature. They reveal the variety of processes that the theory builder has at his command to do his work. The main point of inference as a theory-building activity is that one must go beyond the simple observation and classification of observations if a working theory is to be built.

It is stated repeatedly in the literature that the real test of a theory is the reliability of the prediction that can be made from it. The principal function of a theory is to give greater meaning to a set of events; the greater meaning would involve both what is known about the set of events from observations already made and the unknown expressed through inference of some sort. Events associated with a practice that is perpetuated have greater meaning, in spite of the unknown, because a theory provides a rationale for their existence. In learning theory, for example, the phenomenon of transfer of training must be accounted for to explain certain kinds of learning behavior. Both facts and inference must be posed by the learning theorist before transfer of training can become a useful concept in his theory. But the real test of the theorist's structure of the transfer of training concept comes when transfer effect is predicted by means of the theory in a behavioral situation, and the prediction is subsequently tested. The struggle for prediction in theory was uniquely expressed by Bales:

> As a predictor, the scientific theorizer, like the practical human being he is theorizing about, has to reduce his demands for an omniscient information-gathering apparatus if he wants to predict forward in real time from real information. The trick in improving prediction, since omniscience is so hard to come by, must lie in learning how to get more

> information or how to make more and better inferences from what we have, or both, and to do either or both before something else happens. These are the requirements of naturalistic prediction, and all good theory must eventually face up to them. But as a theorizer, the scientific predictor, like the theorizing human being he is predicting about, has to be prepared to think and talk about states of affairs to which he has had no empirical access, as he struggles by symbolic means to construct an omniscient perspective.[27]

There is a reciprocal relation between research and theory building. A theory builder must conduct research and the results of research contribute to theory development. Particularly in its early states of development, a theory consists of statements that are assumptive or tentative as part of the explanation of the set of events. It also would consist of statements covering events or conditions that belong in the category of the known. Research builds upon what is known by probing from there into what is unknown. Similarly, research procedures are used to move the more tentative generalizations toward the status of laws. The reciprocal relationship lies in the fact that the theory-building tasks drive the theorist into research and control the character of his research. This interaction phenomenon between theory and research is what produces the most systematic research programs which, in turn, produce more valid theories.

Inference, prediction, and research are the activities that really distinguish the work of the theorist. They result in the creating of laws and the identifying of relationships among the laws. Implied in these processes is a movement from hunch, or assumption, to generalization based on some evidence (postulates), to deductions from the postulates, to hypotheses to be researched for purposes of stating laws that improve explanation of the set of events. The quality of theorizing is a function of the precision with which the theorist uses these processes.

Model Building

Model building is a frequently used process in theorizing. Models are analogies. The construction of a model is a way of representing given phenomena and their relationships, but they

[27] Robert F. Bales, "Small-Group Theory Research," *Sociology Today*, edited by Robert K. Merton, Leonard Broom, and Leonard S. Cottrell, Jr. (New York: Basic Books, Inc., 1959), p. 297.

are not phenomena. For example, a model of an ocean liner is not the ocean liner. A set of blueprints is not a house. Functionally, models are used to represent events and event interactions in a highly compact and illustrative manner. So employed, they help to explain facts or events that are puzzling. Thus, they are an aid in theory building.

Parenthetically, we should mention the word "paradigm," for there appears to be considerable uncertainty as to its meaning. At one extreme it is used as a synonym for model. At the other is the very complicated and broad use as uniquely employed by Kuhn. Kuhn suggested ". . . that some accepted examples of actual scientific practice — examples which include law, theory, application, and instrumentation together — provide models from which spring particular coherent traditions of scientific research."[28] Thus, Kuhn uses the paradigm as an example shared by members of the community of science from one generation to another and from the development of one scientific field to another. To point up a major distinction between a paradigm and a model we might say that a paradigm is a framework borrowed from its field of origin and subsequently used in a different field of endeavor; whereas, a model is a representation of a specific set of events about which a theory is being developed.

Now, let us return to our discussion of model building as a device in theorizing. A basic purpose for developing models was implied by Rivett when he defined a model as ". . . a set of logical relationships, either qualitative or quantitative, which will link together the relevant features of the reality with which we are concerned."[29] Thus conceived, the model is a device to help the theorist identify his events and to show the relationships among them. Kaplan was more specific when he distinguished the following different senses in which the term "model" is used:

> (1) any theory more strictly formulated than is characteristic of the literary, academic, or eristic cognitive styles, one presented with some degree of mathematical exactness and logical rigor; (2) a semantical model, presenting a conceptual analogue to some subject-matter; (3) a physical model, a nonlinguistic system analogous to some other being

[28]Thomas S. Kuhn, *The Structure of Scientific Revolutions* (2d ed., enl.; Chicago: The University of Chicago Press, 1970), p. 10.

[29]Patrick Rivett, *Principles of Model Building* (New York: John Wiley & Sons, 1972), p. 9.

> studied; (4) a formal model, a model *of* a theory which presents the latter purely as a structure of uninterpreted symbols; (5) an interpretive model, providing an interpretation *for* a formal theory.[30]

Brodbeck claimed two major uses of the term. On the one hand, a model, she said, is used for highly speculative or quantified theories. On the other hand, the set of laws for one theory can be used as a model for another when the laws of the two are of the same form or isomorphic.[31] In spite of the labels put on various forms or kinds of models, they basically are either replicas of a set of laws or events, or they represent the set of laws or events symbolically. A good point was made by O'Connor when he wrote:

> Thus models in science act like metaphors in language; they enlighten us by suggesting arguments by analogy from known resemblances to resemblances so far unnoticed. They may also act as aids to the type of explanation discussed below. But by themselves, they are no more than a useful stimulus to the process of explanation.[32]

In theorizing, models can serve several functions. Fattu depicted them as providing ways of representation, rules of inference, interpretation, and visualization.[33] Models are useful tools, and theorists make extensive use of them. Like the classification scheme, however, the model is not the theory. The person developing a theory cannot be satisfied with modeling except as a means to an end.

Sub-theory Formation

One of the things that characterizes a mature and comprehensive theory is the development of sub-theories. Sub-theories tend to broaden the scope of a theory as well as to improve the total explanation of the sets of events involved. However, one should not confuse the development of competing theories in a given area with the development of sub-theories in any one theory. For example, it is one thing to talk about the development of learning theories in psychology such as those of

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[30] *Op. cit.*, pp. 267-68.

[31] *Op. cit.*, pp. 88-93.

[32] *Op. cit.*, p. 90.

[33] N.A. Fattu, "A Model of Teaching as Problem Solving," *Theories of Instruction*, edited by James B. Macdonald and Robert R. Leeper (Washington: the Association for Supervision and Curriculum Development, NEA, 1965), pp. 63-64.

Thorndike, Hull, Tolman, or Levin. It is quite another for any single theory to be distinguished by its unique sub-theories in regard to such issues as transfer, motivation, verbal learning, or retention.

SUMMARY

The purpose of this chapter was to present the meaning and consequences of theory building. The following paragraphs seem to be warranted conclusions.

Theory is defined in several ways. There is general agreement that a theory is a set of statements explaining some series of events. Variations in definition are due to the character of the statement and the kind of event relevant to the theory.

The primary functions of theories are description, prediction, and explanation. These functions are both demanding upon and of service to the theorist. They demand the vigor of description and explanation, and at the same time, they serve as a directive force for the theorist's work.

A theory is composed of a set of statements. Essential to the statements are the terms that define the subject matter of the area. In addition to the commonly used terms that have accepted meanings, there are the terms that are basic to the set of events being explained and the essential theoretical terms. Statements of a theory within which the terms are used may be expressed in such forms as statements of fact, definitions, propositions, postulates, hypotheses, deductions, assumptions, generalizations, laws, axioms, or theorems.

The processes of theorizing can be pinpointed further by identifying some of the tasks for people concerned with theory building. As in all scientific work, the careful definition of technical terms and constructs is one important task. Another is the classification of known and assumed information. Probably the most critical and unique tasks in theorizing are the making and testing of inferences and predictions. Two additional activities are the development of models and sub-theories.

The work of the theorist is broad in scope and intensity. Few people will perform at all possible levels. The uninitiated may begin with some limited task, but it is predictable that his work will broaden at every turn.

Finally, I should like to emphasize that there are three primary rules to which anyone who wishes to engage in theory building must adhere. A first rule is to discipline one's use of technical terms. There are two dimensions of this rule. One is to clarify wording to transmit exact meaning, and the other is to consistently use terms throughout the theoretical work. Any theorist is obligated to carefully define his basic and theoretical terms and to be consistent in their use thereafter for these are the primary mechanisms whereby he directs his own procedures and disciplines the communication of his works to others. A second rule is to identify the principle ingredients, i.e., the subjects and processes, that are essential to the theory. To do so it is necessary to arrange in some logical order the knowledge, the key concepts, the assumptions, and the propositions associated with the set of events under study. When a theorist follows this rule, he goes beyond definition and boxes in his whole field of concern. Essentially, classification is the process here. A third rule is to describe and explain relationships among the various parts of the theoretical statements and to explain the character of those relationships. Most theories are complex wholes. The various parts may have individual meaning or significance, but meaning and significance are enhanced as the parts are related to the whole. Logic and research are the primary mechanisms for implementing this rule.

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